

34

~~SECRET~~

50X1-HUM

CENTRAL INTELLIGENCE AGENCY
WASHINGTON 25, D. C.

#5

27 APR 1962

MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : TACTICAL MISSILE AND ARTILLERY COLLECTION:
"The Methodology of Determining the Yield of
Nuclear Charges and the Expenditure of Missiles
for the Destruction of Targets"

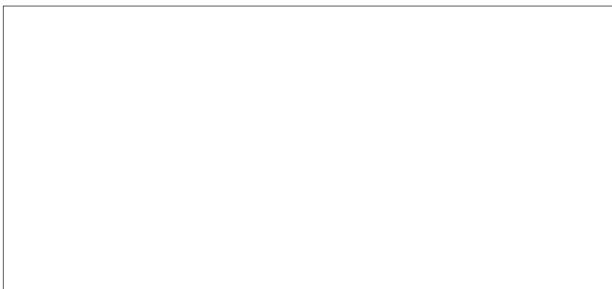
1. Enclosed is a verbatim translation of an article from the Soviet Ministry of Defense TOP SECRET publication entitled Information Collection of Missile Units and Artillery. This publication was formerly called Information Collection of the Artillery and was renamed to include the term "Missile Units" sometime before mid-1960.

2. In the interests of protecting our source, this material should be handled on a need-to-know basis within your office. Requests for extra copies of this report or for utilization of any part of this document in any other form should be addressed to the originating office.

Richard Helms

Richard Helms
Deputy Director (Plans)

Enclosure



50X1-HUM

~~TS#182169~~

Copy No. 34

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

Original: The Director of Central Intelligence

cc: The Director of Intelligence and Research,
Department of State

The Director, Defense Intelligence Agency

The Director for Intelligence,
The Joint Staff

The Assistant Chief of Staff for Intelligence,
Department of the Army

The Director of Naval Intelligence
Department of the Navy

The Assistant Chief of Staff, Intelligence
U. S. Air Force

The Director, National Security Agency

Director, Division of Intelligence
Atomic Energy Commission

National Indications Center

Chairman, Guided Missiles and Astronautics
Intelligence Committee

The Deputy Director of Central Intelligence

Deputy Director for Intelligence

Assistant Director for National Estimates

Assistant Director for Current Intelligence

Assistant Director for Research and Reports

Assistant Director for Scientific Intelligence

Director, National Photographic Interpretation Center

~~TS#182169~~

Copy No. 39

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

COUNTRY : USSR

SUBJECT : TACTICAL MISSILE AND ARTILLERY COLLECTION:
"The Methodology of Determining the Yield
of Nuclear Charges and the Expenditure of
Missiles for the Destruction of Targets"

DATE OF INFO: August 1961

APPRAISAL OF
CONTENT : Documentary

SOURCE : A reliable source (B).

Following is a verbatim translation of an article entitled "The Methodology of Determining the Yield of Nuclear Charges and the Expenditure of Missiles for the Destruction of Targets" which appeared in Issue No. 54, 1961 of the Soviet military publication Information Collection of Missile Units and Artillery (Informatsionnyy Sbornik Raketnykh Chastey i Artillerii).

This publication was formerly called the Information Collection of the Artillery, and was renamed by Issue 51. Issue 54 went to press on 26 August 1961. This publication is classified TOP SECRET by the Soviets and originates with the Tactical Missile and Artillery Headquarters of the Ministry of Defense.

Comment: Cyrillic letters used in the formulas in this report have been transliterated and underlined.

50X1-HUM

~~TS#182169~~

Copy No. 39

-1-

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

The Methodology of Determining the Yield
of Nuclear Charges and the Expenditure
of Missiles for the Destruction of Targets

In Information Collection of Artillery, No. 50, the P-1 chart was recommended to the troops for evaluating the effectiveness of fire. In the course of further work on this problem, the Military Artillery Academy worked out a more improved chart which is published in the present Collection. This chart makes it possible to make a complete evaluation of the effectiveness of fire without arithmetic calculations. Moreover, there is no need to know the probable errors in firing a round, the probable range deflection (veroyatnaya popravka v dalnosti--Vdp) and the probable lateral deflection (veroyatnaya bokovaya popravka--Vbp). The chart can be used in firing operational-tactical as well as tactical missiles. /See chart on pages 15 and 16./

The required yield of a nuclear charge to destroy group or individual targets with one round can be determined with the aid of Tables 1, 2, and 3 which are included in the Manual for Firing and Fire Control. The yields of the nuclear charges in these tables for the destruction of a target are calculated according to the charts, with regard to the level of effectiveness of fire cited in the table.

TS#182169

Copy No. 39

-2-

~~SECRET~~

50X1-HUM

SECRET

50X1-HUM

CSDB-3/649,816

TABLE

Name of Target	Objectives To Be Destroyed	Surface Area (sq km)	Level of Indicators of the Effectiveness of Fire
Guided Missile (URS) Position	Ground equipment (trucks)	3	$S_o = 80\%$
Cruise Missile Position	Cruise missiles	4	$S_o = 80\%$
Control Point	Personnel in blindages	--	$P = 90\%$
Depot for Nuclear Charges or Supply Station	Brick buildings of few stories	4	$S_o = 80\%$
Large Bridge	Metal bridge	--	$P = 70\%$
Concentration of Reserves	Personnel in the open	From 2 to 30	$S_o = 25 \text{ to } 30\%$
Troops at Positions	Personnel in trenches, blindages, or tanks	From 2 to 30	$S_o = 25 \text{ to } 30\%$
Airfield	Jet bombers or fighters	From 2 to 30	$S_o = 25 \text{ to } 30\%$
Military Industrial Objectives, Centers, Ports, etc.	Multi-story buildings	From 2 to 30	$S_o = 25 \text{ to } 30\%$
Tank Troops	Heavy and medium tanks	From 2 to 30	$S_o = 25 \text{ to } 30\%$
Troops on the March or in Concentration Areas	Trucks	From 2 to 30	$S_o = 25 \text{ to } 30\%$

TS#182169

-3-

SECRET

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

In firing for neutralization, the norms indicated in the table must be decreased by 1.5 to 2 times, as a consequence of which, the reliably destroyed surface area S_0 is reduced to 15 to 20 percent.

Example 1.

Determine the required yield of the nuclear charge for the destruction of an enemy missile subunit in firing the R-170 missile, if the range of fire is 123 km and it is an air burst.

Solution.

From Table 1 in the Manual, by interpolating between ranges of 100 and 150 km, we find the acquired yield of the nuclear charge $q \approx 80$ kilotons.

Example 2.

Determine the yield of the nuclear charge for the neutralization of enemy personnel in the open in an area of 9 square km while firing the same missile at a range of 154 km. It is an air burst.

Solution.

In Table 2 of the Manual, by interpolating, we find the required yield for the destruction of the target $q=10$ kilotons. For neutralization, we decrease the equivalent of the charge by two times and obtain $q=5$ kilotons.

In the event that the fire mission cannot be accomplished with one round, then the needed expenditure of missiles of the given yield can be found with the aid of Table 4 in the Manual.

~~TS#182169~~

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

Example 3.

For the destruction of a target with one round, a nuclear charge with the yield $q=150$ kilotons is required. A battalion has nuclear charges with a yield of 30 kilotons each. Determine the expenditure of missiles with a yield of 30 kilotons for the destruction of the indicated target.

Solution.

From Table 4, with $q=150$ kilotons and $q=30$ kilotons, we determine the required expenditure of missiles as $N=3$.

As is apparent, the indicated tables allow one to determine rather quickly the required yield of a nuclear charge for the destruction of a target, but they do not permit one to make an evaluation of the effectiveness of fire. Therefore, at the present time, appropriate charts for this purpose can be used in the staffs of missile troops and artillery.

By means of the chart (Sketch 1), one can determine the required yield (q) of a nuclear charge for the destruction of any target, the reliably destroyed surface area of the target S_0 , the mathematical expectation of loss M and the maximum possible surface area of destruction S_{max} , the probability of destroying an individual target P , the safe radius of the burst (R_{ip}) and the height of the burst (h_y).

The principle of working on the chart consists of the successive drawing of horizontal and vertical lines at particular intervals. To avoid drawing the lines with a pencil, a ruler is used and the ends of the lengths are marked with dots.

The entries on the chart for resolving all possible problems are:

~~TS#182169~~

-5-

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

- surface area of the target S_{ts} ;
- reliably destroyed surface area S_o ;
- mathematical expectation of loss M ;
- probability of destruction of an individual target P ;
- range of fire D ;
- nature of the target and type of burst (air V , or ground N);
- yield of the nuclear charge q ;
- radius of the zone of destruction R_z .

The surface area of the target S_{ts} in square kilometers is given twice on the chart; on the lower part of the vertical axis and on the radial lines in the upper left part.

The range of fire in kilometers is indicated on the chart in the lower right and the upper left. The range lines are numbered:

- | | |
|---------------------------------|--------------------------------|
| a. <u>for the R-170 Missile</u> | b. <u>for the R-30 Missile</u> |
| Line 1 - range 60 km | Line 1 - range 10 to 15 km |
| Line 2 - range 100 km | Line 2 - range 15 km |
| Line 3 - range 150 km | Line 3 - range 20 km |
| Line 4 - range 200 km | Line 4 - range 30 km |

The dotted lines are made for the symbols M , P , and D to determine the probability and mathematical expectation.

~~TS#182169~~

-6-

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

To determine the required yield of the nuclear charge q in destroying an individual target, the entries on the chart are:

- the probability P ;
- the range $\underline{D}$;
- the nature of the target and type of burst ($\underline{V}$, $\underline{N}$).

To determine the required yield of the nuclear charge q in destroying a group target, the entries are:

- the target area $\underline{S}_{ts}$;
- the range $\underline{D}$;
- reliably destroyed surface area S_o ;
- the nature of the target and type of burst ($\underline{V}$, $\underline{N}$).

The lower left part of the chart has lines reflecting the dependence of the radius of the zone of destruction on the yield of the nuclear charge. The nature of the target is indicated on these lines by the following abbreviated designations:

OZhS-V; OZhS-N
(otkrytaya zhivaya sila-V);
(otkrytaya zhivaya sila-N)

--personnel in the open
(in all legends, an air burst is indicated by the letter $\underline{V}$, and a ground burst by the letter $\underline{N}$);

ZhS tr.
(zhivaya sila v transheyakh)

--personnel in trenches;

ZhS bl.
(zhivaya sila v blindazhakh)

--the same, in blindages;

TS#182169

-7-

~~SECRET~~

50X1-HUM

SECRET

50X1-HUM

CSDB-3/649,816

ZhS tank (zhivaya sila v tankakh)	--the same, in tanks
RI; RB (reaktivnyy istrebitel) (bombardirovshchik)	--jet fighters (bombers);
M ekz (maloetazhnoye kirpichnoye zdaniye)	--brick buildings of few stories;
Avt. S-sn (avtomobil, samolet-snaryad)	--vehicles, cruise- missiles;
Br. Or. ZA. R (bronetransporter, orudiya zenitnoy artillerii, raketa na startovoy positsii)	--armored carriers, antiaircraft artillery guns, missiles on launch sites;
LT, Or., NA, NURS (legkiy tank, orudiya nazemnoy artillerii, neupravlyaemyy reaktivnyy snaryad)	--light tanks, ground artillery guns, free rockets;
STT (sredniy i tyazhelyy tank)	--medium and heavy tanks;
MZh (most zheleznodorozhnyy)	--railroad bridge;
1	--line for determining the radius precluding the destruction of OZhS.

Let us examine the procedure for solving problems
with the use of the chart.

TS#182169

SECRET

50X1-HUM

~~SECRET~~

50X1-HUM

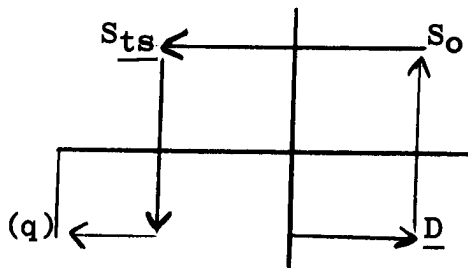
CSDB-3/649,816

Example 4.

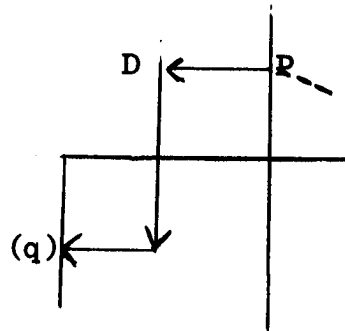
Determine the required yield of a nuclear charge while firing the R-170 missile if the range of fire is $D=60$ km, the target is personnel in trenches in a surface area of $S_{ts}=9$ sq km, the reliably destroyed surface area is $S_o=50$ percent of the target area, it is an air burst.

Solution.

Following the movements (Sketch 2) and making use of the continuous lines on the chart, we obtain $q=60$ kilotons.



(Sketch 2)



(Sketch 3)

Example 5.

Determine the required yield of a nuclear charge for the destruction of an Honest John free rocket mount in position while firing the same missile, if the range of fire is $D=82$ km and the probability of destruction is $P=90$ percent. It is an air burst.

TS#182169

~~SECRET~~

50X1-HUM

SECRET

50X1-HUM

CSDB-3/649,816

Solution.

Following the movements (Sketch 3) and using the dotted lines P and D on the chart, we obtain $q=160$ kilotons.

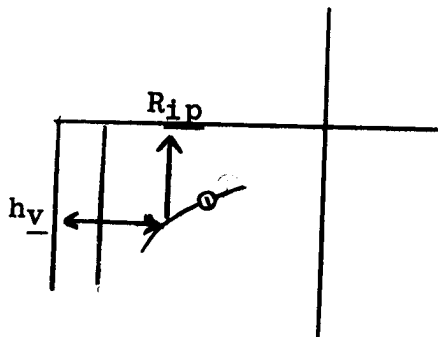
The value of the probability P is taken at the upper part of the vertical axis at the points of beginning of the dotted lines of mathematical expectation.

Example 6.

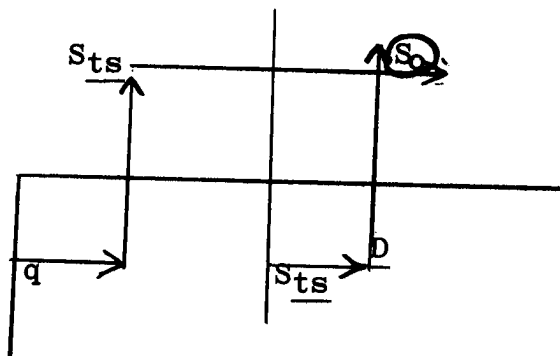
Determine the radius R_{ip} , precluding the destruction of personnel in the open, and the altitude of a high air burst h_v for the R-170 missile, if the yield of the nuclear charge is $q=100$ kilotons.

Solution.

Following the movements indicated on (Sketch 4), we determine



(Sketch 4)



(Sketch 5)

$$R_{ip} = 5.6 \text{ km,}$$

$$h_v = 570 \text{ m.}$$

TS#182169-

SECRET

50X1-HUM

 SECRET

50X1-HUM

CSDB-3/649, 816

In evaluating the effectiveness of fire against a group target, one determines first of all the reliably destroyed surface area of the target S_0 . If time permits, one makes a complete evaluation of the effectiveness of fire, i.e., one determines S_0 , M , and S_{max} .

Determining the three characteristics of the loss distribution (S_0 , M , and S_{max}) makes it possible to know more completely the practical bounds of distribution (S_0 and S_{max}) and the average expected value of the loss (M).

In evaluating the effectiveness of fire against an individual target, one determines the probability of its destruction P .

Example 7.

Make a complete evaluation of the effectiveness of fire by a R-170 missile with an air burst against enemy personnel in the open and located in an area $S_{ts}=10$ sq km. The range of fire is $D=125$ km, and the yield is $q=30$ kilotons.

Solution.

- a. We determine the reliably destroyed surface area S_0 . For this, the movements (Sketch 5) along the continuous lines of the chart are used. $S_0=57$ percent.
- b. We determine the mathematical expectation of loss M according to the dotted lines (Sketch 6). $M=73$ percent.
- c. We determine the greatest degree of destruction S_{max} (Sketch 7). $S_{max}=100$ percent.

TS#182169

-11-

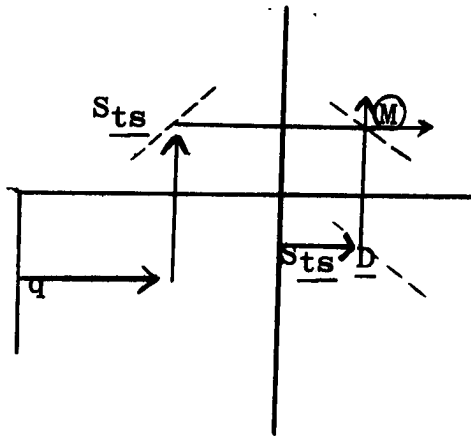
 SECRET

50X1-HUM

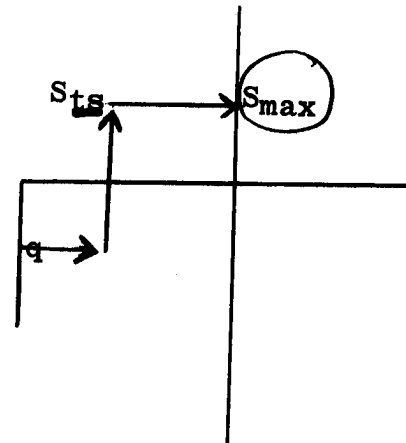
~~SECRET~~

50X1-HUM

CSDB-3/649,816



(Sketch 6)



(Sketch 7)

The symbol S_{max} is read on the vertical axis, using the beginnings of the lines S_0 . When $S_{max} > 100$ percent, one takes $S_{max} = 100$ percent.

Example 8.

Determine the probability P of destroying an individual enemy target (cruise-missile) in position while firing the R-170 missile, if the range of fire is $D=150$ km, the yield of the nuclear charge is $q=50$ kilotons, and it is a ground burst.

Solution.

Following the movements (Sketch 8), we find that $P=83$ percent.

After determining the location of the ground zero point of the burst as needed according to the chart, one can determine the result achieved by the firing.

TS#182169

-12-

~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816

For this, it is necessary to know:

- l -- the distance of the ground zero of the burst from the center of the target;
- q -- the yield of the nuclear charges;
- S_{ts} -- the surface area of the target.

The procedure for determining the magnitude of covered surface area of the target is presented in (Sketch 9).

Example 9.

Determine the covered part of the surface area of a target (personnel in the open) if the entire target area is $S_{ts}=12$ sq km, the distance of the burst's ground zero epicenter from the center of the target is $l=1,500$ m. The yield of the nuclear charge is $q=20$ kilotons.

Solution.

Along the line $q=20$ kilotons, we draw a direct line to the line corresponding to the personnel in the open. From the point of intersection, we draw a vertical line to the intersection with the line $S_{ts}=12$ sq km. From this point of intersection, we draw a horizontal line to the right.

TS#182169

-13-

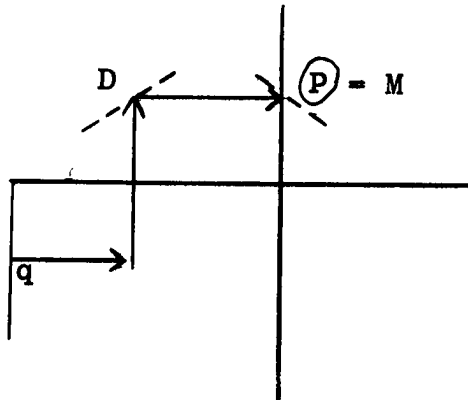
~~SECRET~~

50X1-HUM

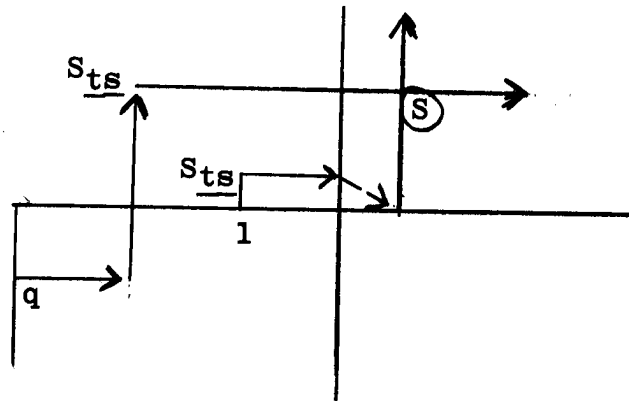
~~SECRET~~

50X1-HUM

CSDB-3/649,816



(Sketch 8)



(Sketch 9)

We lay out 1-1,500 m along the horizontal line to the left from the center of the chart, and from the end of this segment we raise a perpendicular line to the intersection with the line of the surface area of the target $S_{ts}=12$ km. We measure the vertical segment and lay it out along a horizontal line to the right from the center of the chart.

From the end of the given segment, we raise a perpendicular line to the intersection with the horizontal line which was drawn at first in the upper right portion of the chart. At the point of intersection, using the lines S_0 , we read the result:

$S=49$ percent of the surface area of the target.

TS#182169

-14-

~~SECRET~~

50X1-HUM

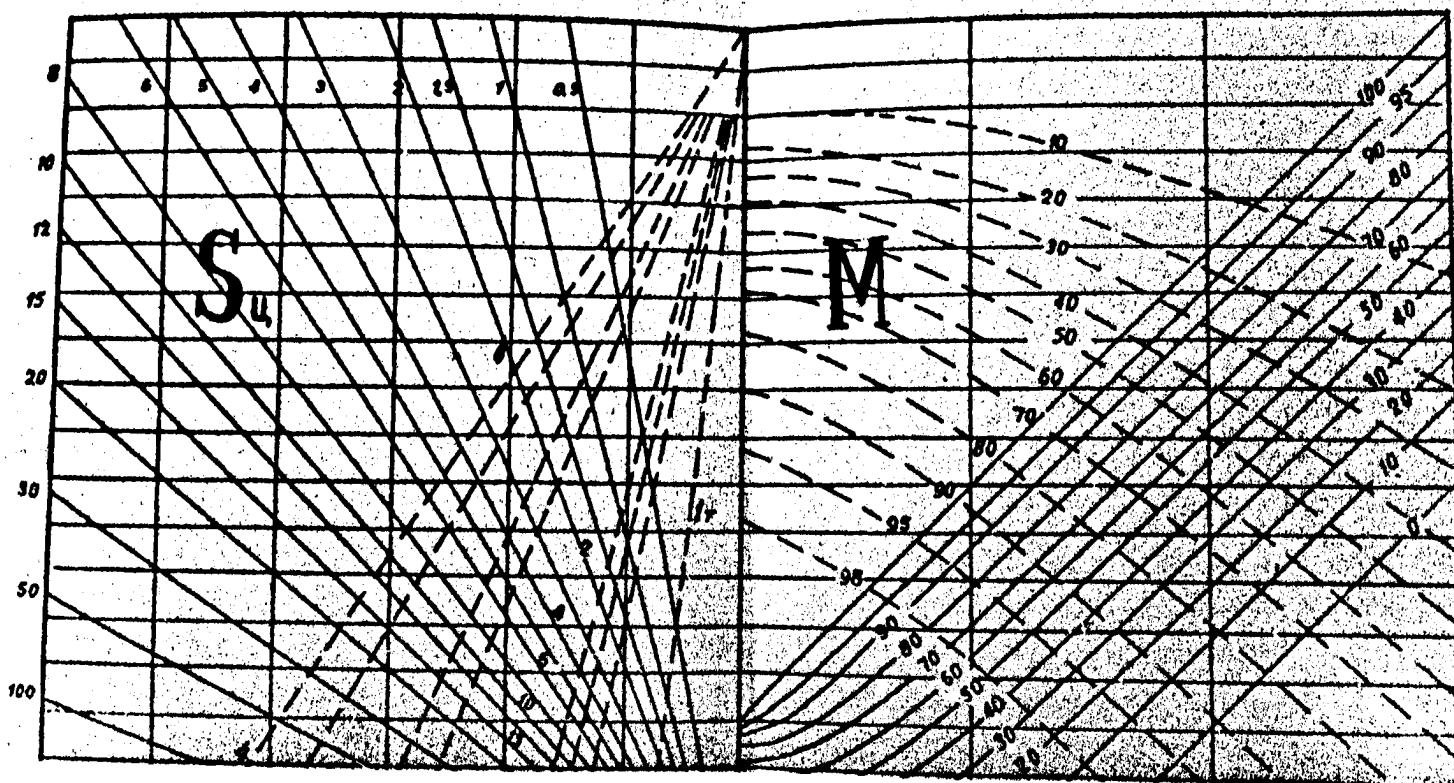
~~SECRET~~

50X1-HUM

CSDB-3/649,816

Chart for Evaluation of Effectiveness of Fire

(continued of next page)



TS#182169

Copy No. 39

-15-

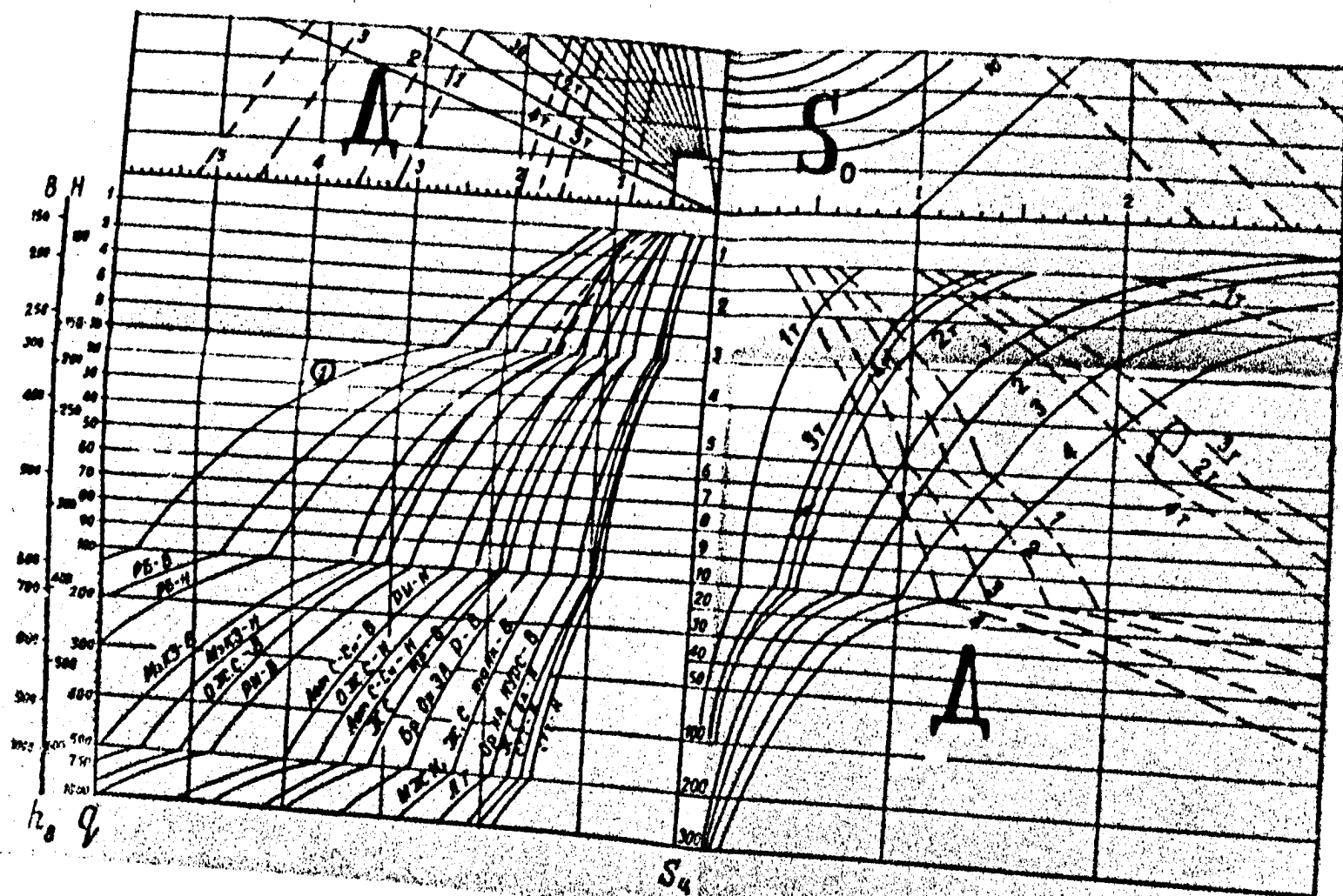
~~SECRET~~

50X1-HUM

~~SECRET~~

50X1-HUM

CSDB-3/649,816



~~TS#182169~~

-16-

Copy No. 39

~~SECRET~~

50X1-HUM